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CHANGES IN SOCIAL WELFARE IN SINGAPORE – 1982-1999

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Abstract: This paper examines the changes in social welfare in Singapore using Labour Force Survey data. To study the changes and dominance, both ordinal and cardinal measures are used. By Lorenz Dominance social welfare in Singapore during 1999 is less than in 1991 while unambiguous conclusion cannot be made on the welfare ranking of 1982 and 1991 or of 1982 and 1999. 1999 ranks first according to the Generalized Lorenz Dominance; however, this criterion is also unable to make any unambiguous ranking between 1982 and 1991. The ranking based on Sen-Dagum-Yitzhaki-Sheshinski Social Welfare Function shows a continuous increase in the social welfare in Singapore. But when a more general Social Welfare Function is used a different ordering might occur.

JEL classification: D39, D69
Keywords: Lorenz Dominance, Generalised Lorenz Dominance, Social Welfare Function, Equity, Efficiency, Singapore Economy

I. Introduction

Singapore, a city-state of a little less than four million people, recorded the world's ninth highest GNP per capita (US $30, 060) in the list of 174 countries covered by the *World Development Report*, 1999/00. However, an alternative set of estimates using purchasing power parity criteria ranked Singapore as fifth. And it is ranked 24th in the Human Development Index (UNDP, 2000).[1] Singapore is among the fastest growing economies of East Asia. Thus, its average rate of growth (in per capita real GNP) was 6.4 % during 1980-90 and 8.7 % during the first half of the nineties. It, however, slowed down in the mid-nineties, with a decline from 9.8% to 7.8% during 1995 to 1996, then decreasing sharply to 0.7% in 1998. This is largely due to the adverse impact of the East Asian crisis. It has, however, recovered quickly, and grew at a rate of 5.4 % in 1999.

The World Bank (1993) emphasized two characteristics of the economic growth experience of Singapore (along with other high performing countries of East Asia) as the defining characteristics of 'miracle': high growth and reduced income inequality. However, in due course, one secret of this miracle has been revealed: that the inequality scenario of Singapore is approaching the Latin American experience. At the end of May 2000, the Singapore Department of Statistics released to the local media an occasional paper on income disparities in Singapore.[2] It indicated a rise in income inequality based on Gini ratios for household income from work, from data compiled as part of the comprehensive annual labour force surveys. The Gini was stable at 0.44 in 1990, 1995 and 1997, but rose to 0.45 in 1998 and 0.47 in 1999.

The data used in this study refer to household income and thus do not take into account the variations in the size of households across income levels and classes. Thus, in a household income class, say, $1,000 to $1,400, or at an average income

[1] Smith (1993: 95) has remarked that Singapore 'may be advanced in terms of income than in social development' and further argued that its low rank in HDI is due to low index for 'educational attainment'.

[2] *Is Income Disparity Increasing in Singapore*, Occasional Paper, Singapore: Department of Statistics, May, 2000. Some of the earliest researches on income inequality in Singapore were by Pang (1975), Rao and Ramakrishnan (1980) and Liu and Wong (1981).

level of $1,200, there may be households of many sizes: 1, 2, 3, 4, and so on. On a per person basis, the household of size 2 enjoys an income of $600, as against the $300 of household of size 4 and $200 of household of size 6, for instance. All computations on income inequality that do not take explicit account of variations in household size are of somewhat limited significance in a comparative context (over time or across space). Ginis that are not properly adjusted for household size and composition changes across income classes are of little use either to evaluate development performance or to entertain policy debates. Mukhopadhaya (forthcoming) and Mukhopadhaya and Rao (forthcoming, 2001) have demonstrated that the Singapore economy faced a high rate of inequality (average Gini: 0.460 in the 1980s; in the 1990s the Gini did not fall and was around 0.470).

This paper studies the change in social welfare in Singapore using the Labour Force Survey data (published by Department of Statistics, Government of Singapore) of 1982, 1991 and 1999. The next section presents briefly the nature of data and definition of income used in the surveys. Section III analyses the empirical results of trends in inequality in Singapore. Section IV uses a Lorenz Dominance approach to find out the welfare trend in Singapore over time. The next section utilizes the Generalised Lorenz Dominance procedure to scrutinize the trend of welfare in Singapore. Section VI presents an analysis using a Sen-Degum-Yitzhaki-Sleshinski Social Welfare Function to judge the trends in total welfare and the trends in its components (viz, equity and efficiency). Section VII introduces and uses a general class of Social Welfare Function, where the values of parameter weight on equity can be varied. Section VIII analyses other aspects of social welfare. The last section makes some concluding remarks.

II The Data

The data on income from *The Report on the Labour Force Survey* is used in the analysis to follow. The concept of income, as defined in the Labour Force Surveys, is gross monthly income considered as total earned income from employment in the preceding full calendar month. For employees this includes wages and salaries, allowances, overtime, commission, tips, bonus and the employees' contribution to the Central Provident Fund. For employers and own account workers it is the total

receipt from sales and services less operating expenses. Thus the surveys covered both the earned and unearned income. Since unearned income is more unevenly distributed (because of its direct relation to wealth), earning distribution may understate the degree of overall inequality.

LFS publishes data by income groups and by actual levels. Thus, except for the highest and the lowest income classes class means are assumed to equal the arithmetic means of the upper and lower bound of the classes. For the highest and the lowest income classes, which are open ended, no average income data or gross income estimates are provided. For the year 1982, the mean of the lowest income group of "below $200" was assumed to be $125. For 1991 and 1999, the mean for the lowest income class of "below $400" was set at $260. The highest income class in the survey reports for 1982 and 1991 was "$3000 and above" and for 1999 it is "$6,000 and above". Two approaches have been used for the estimation of the mean for the highest income class. One is based on the interpolation at the appropriate income groups of the data on the assessed income distributions from the annual reports of the Inland Revenue Department and the other is based on fitting a Pareto curve for the last two income classes.[3] The estimates from the two methods were scrutinized to arrive at the means for the highest open-ended class.

III. Trends in Income Inequality in Singapore

To gain an overview of the trend in inequality in Singapore over the last two decades we present Table 1 which contains the cumulative decile shares of per capita gross incomes and the Gini coefficients at different survey periods.

It may be noted that inequality of labour force income in Singapore is on the increase over the period as clearly displayed by the rising value of the Gini coefficient and from the ratio of mean incomes of the top 10% to the bottom 20%. Looking at the decile share, we find that there is a secular decline in the share of the bottom

[3] The process is as follows. Let the lower income bound of last two groups be Y_1 and Y_2. Also let the number of persons with incomes above Y_1 and Y_2 be N_1 and N_2 respectively. The 'Pareto a' can be found as $D\log N / D\log Y$. Then the estimated mean income of the last group is calculated from Van der Wijk's law as $(a/a\text{-}1)Y_2$ (see Rao and Ramakrishnan, 1980; Kakwani, 1980 and Cowell, 1995).

decile. It is observed that only around 20% of the total national income goes to the bottom 50% of the population and the top decile enjoys 40% of the total national earnings.

Table 1

Trend of Income Inequality in Singapore: 1982, 1991 and 1999

Decile	Cumulative Shares of Income (%)		
	1982	1991	1999
Lowest	2.46	1.44	1.24
Second	6.29	5.13	4.14
Third	10.12	9.86	8.56
Fourth	15.29	15.23	13.15
Fifth	21.68	21.87	19.54
Sixth	28.06	29.95	26.81
Seventh	36.49	39.55	35.40
Eighth	46.42	51.20	46.76
Ninth	61.10	67.45	61.32
Top	100	100	100
Gini coefficient	0.460	0.471	0.476
Ratio of Means of top 10% and bottom 20%	12.34	15.88	18.70

Computed from the LFS of 1982, 1991 and 1999

It is evident that for the lower forty per cent of the population the income share has steadily declined; however, for the upper decile income has not steadily increased. The decline in the share of income going to the lower deciles is quite spectacular. This trend is sometimes attributed to the structural changes in the economy since the eighties. As Singapore began losing its competitive advantage in labour intensive industries in the 1980s, the Government initiated a programme of economic restructuring and encouraged the move towards skill and technology intensive industries. The services sector (notably the financial services sector) was also actively promoted.

As the restructuring programme gained momentum, those with required qualifications were well paid and for those without the appropriate skills earnings remained stagnant. Earnings were thus stretched at both ends. Foreign talent was

welcomed in the face of intensifying global competition, while foreign unskilled workers were brought in to take over manual jobs. Earnings at the top rose at a relatively higher pace than for those at the bottom.

As the economy recovered from the financial crises in 1999, with GDP growing at 5.5%, the Gini rose to an all time high of close to 0.48. The recession must have resulted in further restructuring of firms and the recovery is now witnessing the impact of that restructuring: a widening of income inequality. The buzzword in recent years has been "foreign talent". It is widely believed that some of the CEOs and other top executives in Singapore may be receiving very high salaries and bonuses – comparable to their US colleagues, while no such favourable trend is likely for all others in general and low-level employees in particular.

IV The Lorenz Dominance Approach

Bergson (1938) introduced the concept of the Social Welfare Function (SWF) which would depend on the amount of the non-labour factors of production employed by each producing unit, the amount of labour supplied by each individual and the amount of produced goods consumed by each individual. Then SWF is a real valued function defined on a set of alternative social states. Samuelson (1947) investigated various uses for which SWF can be utilized in welfare economics. The most general form of SWF is the Bergson-Samuelson SWF, expressed as:

$$W = W(u_1(x_1), u_2(x_2), \cdots, u_n(x_n)) \tag{1}$$

where $u_i(x_i)$ is the utility obtained by the person i for his/her income x_i. *A priori*, there is not much that can be said about the form of the SWF. The form varies from person to person. Although the function may take any form the function is supposed to be increasing, unique up to the monotonic transformation and permutation symmetric in incomes.

Atkinson's (1970) seminal paper[4] considered the ranking of social states with the same mean income on the basis of an additive separable SWF as:

[4] Also see Kolm (1966).

(2) $$W = \sum_i u_i(x_i).$$

The form of the utility function might also vary from person to person. However, Atkinson (1970) proved that with the minimum restriction of concave utility function (that is assuming diminishing marginal utility of income) it is possible to show that for a quite broad class of SWF, Lorenz ordering can rank alternative social states. A common way of describing income distribution is the Lorenz curve, which is defined as the relationship between the cumulative proportion of the income units and the cumulative proportion of income received when units are arranged at ascending order of their incomes. Thus Atkinson shows that if the Lorenz curve of one state lies north east of another the distribution of income corresponding to the first is said to be better than the latter. To present it formally:

> If $F_1(x)$ and $F_2(x)$ are two distributions with corresponding mass functions $f_1(x)$ and $f_2(x)$ respectively with the same mean income and if $L(p)$ is the Lorenz curve, then $L_{F_1}(p) \geq L_{F_2}(p)$ in the interval $0 \leq p \leq 1 \Leftrightarrow \sum u(x) f_1(x) \geq \sum u(x) f_2(x)$ for utility functions such that $u'(x) > 0$ and $u''(x) < 0$.[5]

However, if the two Lorenz curves cross, it is always possible to find out different concave utility functions which can rank two social states differently.[6]

The observation in Table 1 is that the Lorenz curve of 1999 is outside of the Lorenz curves of 1991 (see also Figure 1). However, the Lorenz curve of 1982 intersects that of 1991 from below at the sixth decile. And the Lorenz curve of 1999 intersects that of 1982 from below at the eighth decile. We have seen that the Lorenz curve allows for an unambiguous comparison of the regular distribution in the cases where the curves do not intersect. This requires that for all k, the share of the bottom k decile at time t is greater than that at time t^*. In such a situation the distribution at

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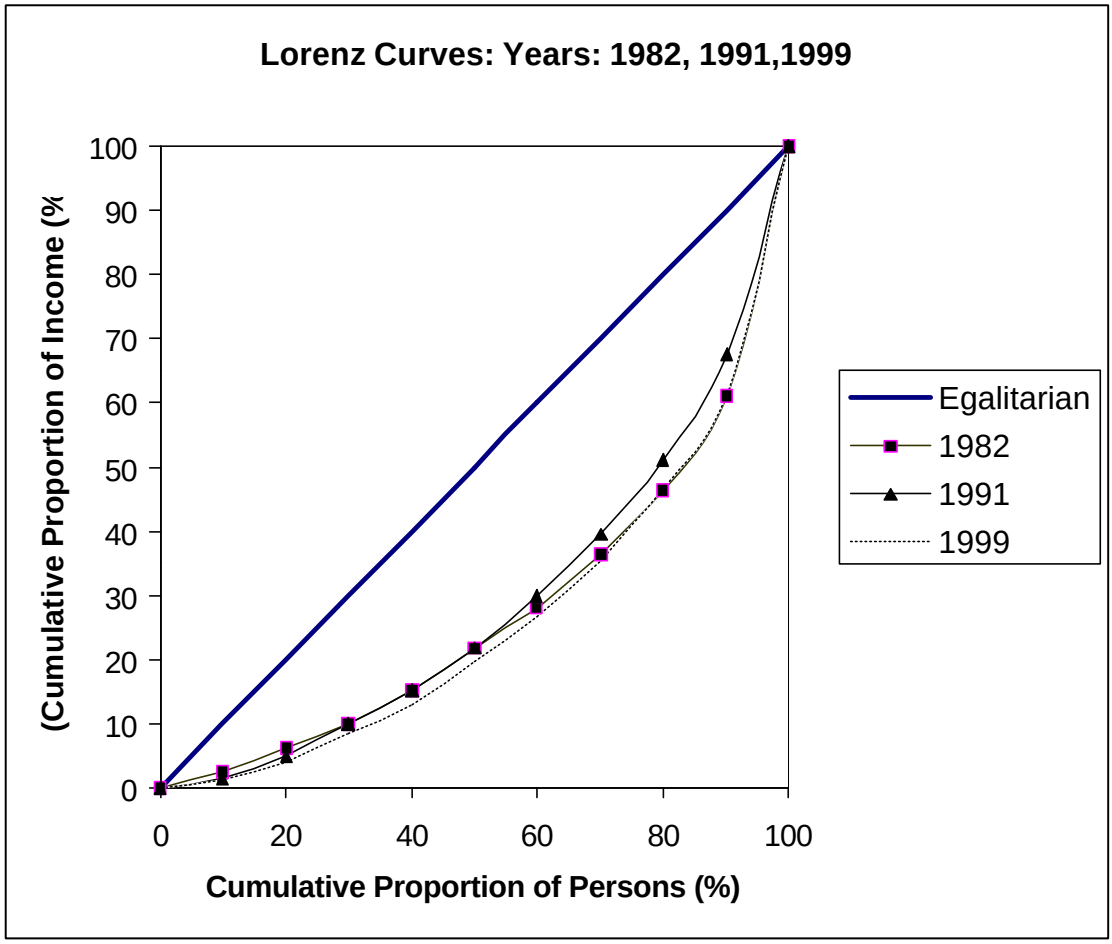
[5] Dasgupta, Sen and Starett (1973) showed that the strict concavity can be relaxed to Schur-concavity.

[6] Note that the criterion is still true when the dominating Lorenz curve has a higher mean income.

time t is Lorenz superior to that at time t^*.[7] From Table 1 and Figure 1, the first conclusion is that an unambiguous comparison, regarding welfare ranking, cannot be made except for 1991 and 1999 (though the Gini coefficient is increasing from 1982 to 1999). Thus we can only say that the social welfare in Singapore during the year 1991 was higher in comparison to 1999. Furthermore, since the per capita income has changed during this period we are unable to make welfare judgments on the basis of Lorenz dominance.

Figure 1



[7] Also for this comparison the errors surrounding the estimates of the distribution is another aspect to consider. Beach and Davidson (1983), Bishop, Chakravorty and Thistle (1989) considered the sampling variability and tried to indicate whether crossing of Lorenz curves (and Generalised Lorenz curves) were statistically significant or not. Other references can be found in the above mentioned articles. However, present analyses do not follow this route.

V A Generalised Lorenz Dominance Approach

Atkinson's (1970) paper created a lot of excitement in the literature of inequality, however, it is observed that Lorenz Dominance as a criterion of welfare comparison gives only a partial ordering of the income distribution. This is because the Lorenz curves intersect (this was also the observation for our Singapore exercise). Moreover, Lorenz Dominance permits comparisons only when distributions have the same mean. In our case we are interested in examining welfare changes of Singapore over time, and it is important to notice that mean income had changed over time. Moreover, the Lorenz Dominance criterion has completely ignored the economic efficiency/growth aspect of a social welfare consideration. Shorrocks (1983) extends Atkinson's formulation by introducing the concept of Generalised Lorenz Dominance. The Generalised Lorenz curves can be obtained by scaling the ordinary Lorenz curves up by the states' mean incomes. Thus if the Lorenz curve of a distribution is $L(p)$ and the mean income of the distribution is m then the Generalised Lorenz curve of this distribution is given by $mL(p)$. According to Shorrocks (1983) if the Generalised Lorenz curve of one state lies north east of another, the social welfare corresponding to the first is said to be better than the latter. To present it formally:

> If $F_1(x)$ and $F_2(x)$ are two distributions with corresponding mass functions $f_1(x)$ and $f_2(x)$ and mean incomes m_1 and m_2 respectively, then $m_1 L_{F_1}(p) \geq m_2 L_{F_2}(p)$ in the interval $0 \leq p \leq 1 \Leftrightarrow \sum u(x) f_1(x) \geq \sum u(x) f_2(x)$ for all strictly concave utility functions.[8]

Thus it demonstrates that the ranking of two income distributions with different means can only have an unambiguous welfare ranking if the Generalized Lorenz curves do not intersect. Moreover, Shorrocks (1983) demonstrates that even if ordinary Lorenz curves of two distributions intersect, the condition of Generalized Lorenz dominance may still be satisfied.

[8] See Kakwani (1984).

As a next step in our analysis we have constructed the Generalised Lorenz curves for three years. Using 1985 as the base year the per capita monthly real income of Singaporeans was found to be S$ 987.90, S$ 1616.85 and S$ 2642.63 respectively for the years 1982, 1991 and 1999. Real income has increased over time in Singapore. Table 2 presents the decile points of the Generalised Lorenz curves for the different years.

Table 2

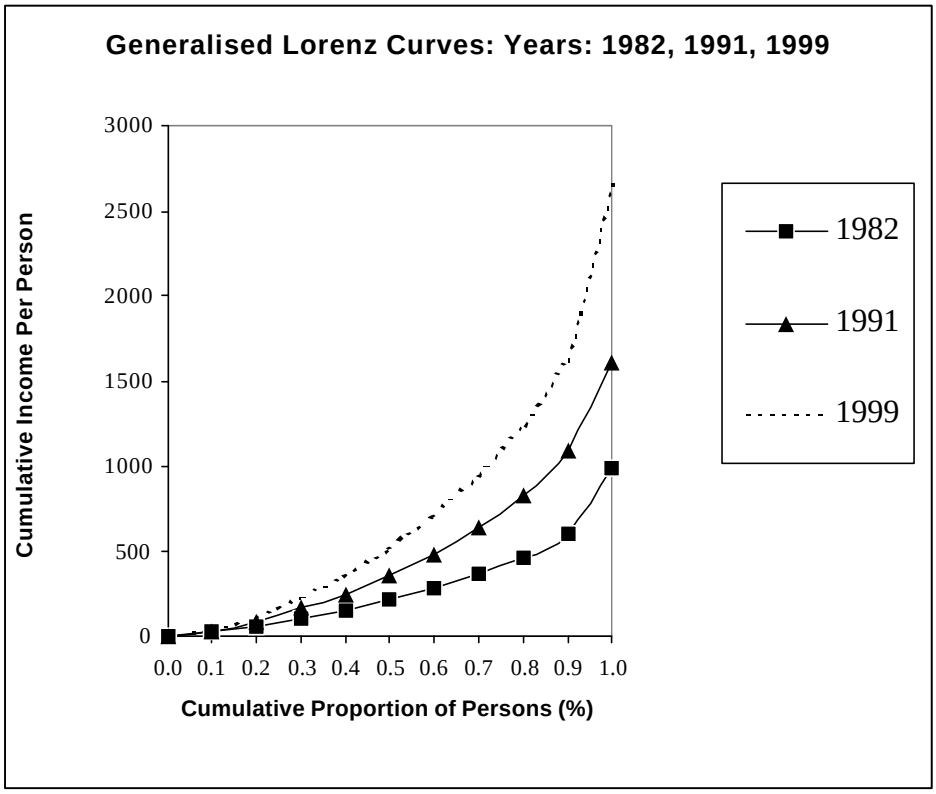
Points of Generalised Lorenz Curves at different deciles: 1982, 1991, 1999

Deciles	Cumulative shares of Income (%)		
	1982	1991	1999
Lowest	24.32	23.27	32.82
Second	62.17	82.93	109.34
Third	100.01	159.44	226.28
Fourth	151.06	246.32	347.45
Fifth	214.13	353.57	516.50
Sixth	277.21	484.29	708.59
Seventh	360.46	639.45	935.49
Eighth	458.55	827.79	1235.60
Ninth	603.59	1090.56	1620.44
Mean income	987.90	1616.85	2642.63

Computed from the LFS of 1982, 1991 and 1999

Figure 2 represents the Generalised Lorenz curves of different years. We observe that for Singapore the Generalised Lorenz curves are increasing at a faster rate with time at the higher decile points. Both from Table 2 and Figure 2 it may be noticed that the Generalised Lorenz curve for 1982 intersects that of 1991 at the second decile. The Generalised Lorenz curve of 1991 (and also that of 1982) always lies below the Generalised Lorenz Curve of 1999. The Lorenz curve of 1991, as shown in the previous section, was above the Lorenz curve of 1999. Table 2 and the corresponding Figure, thus, indicate that for the top 90 percent population of 1991 the cumulative income per capita was higher in comparison to that of 1982.

Figure 2



Thus in our empirical analysis we find that the Generalised Lorenz dominance criterion resolves some of the *intersection* of ordinary Lorenz curves, however, generate new crossings at the same time. Therefore, this provides only a partial ordering of social states.

VI A Social Welfare Function Approach

As both the Lorenz Dominance and the Generalised Lorenz Dominance provide only partial ordering of the social welfare of Singapore over time, for complete ordering we need a cardinal Social Welfare Function (SWF) that provides numerical values to all possible social states. As we know that the Gini index (G) is defined as twice the area between the Lorenz curve and the 45^0 egalitarian line, then ($1-G$) is twice the area below the Lorenz curve. In the same fashion a cardinalisation of Generalized Lorenz curve can be done by finding the area below the Generalized Lorenz curve:

(3) $$2\int_0^1 mL(p)dp = m(1-G),$$

and this could be denoted as a SWF.

Since the utilitarian social welfare function, given by equation (1) depends only on individual utilities which in turn depend on the consumption bundle, or real income of each person, it does not allow for any externalities. While the level of utility of a person may depend on his/her consumption bundle or income, some disutility may be created due to inequity in the society as a whole. It is agreed that equity and efficiency are the twin concerns of a social planner or decision-maker. Therefore, a common non-utilitarian form of the of the Bergson-Samuelson SWF may be written as:

(4) $$W = W(S, q)$$

where S stands for total income representing efficiency and $q = q(x_1, x_2, \cdots, x_n)$ denotes a measure of inequality representing inequity. A SWF of the above type must satisfy the condition:

(5) $$\frac{\partial W}{\partial S} > 0, \text{ and } \frac{\partial W}{\partial q} < 0.$$

This would mean social welfare will increase with rising total income and will decrease with rising inequality. Obviously, the set of admissible SWFs satisfying these conditions is enormous. In order to narrow down the set, further restrictions are needed. These restrictions may be specified in terms of a number of axioms. On the basis of a set of four axioms, Sen (1974) arrived at a specific form of the Bergson-Samuelson class of SWFs which is:

(6) $$W = m(1-G)$$

Sen (1976) shows that this index, calculated from income distribution, is a sub-relation of social preference relation defined in the distribution of commodities. Dagum (1990, 1993) arrived at the same SWF from an utilitarian premise. Alternatively Yitzhaki (1979, 1982) showed that this index could be based on relative deprivation. Sheshinski (1972) also arrived at this index from the Gini coefficient. Thus we will call this social welfare function the Sen-Dagum-Yitzhaki-Sheshinski SWF (or, S-D-Y-S SWF for short).

We will estimate, in this section, the SWF of (6) in order to examine the changes in social welfare in Singapore during the period 1982 to 1999. Let us consider that both the arguments in SWF of (4) change over time. Then we can find out the total derivative of (4) with respect to time as:

(7) $$\frac{dW}{dt} = \frac{\partial W}{\partial S}\frac{dS}{dt} + \frac{\partial W}{\partial \boldsymbol{q}}\frac{d\boldsymbol{q}}{dt}$$

Using (6) for the specific form of the SWF we get:

(8) $$\frac{dW}{dt} = (1-G)\frac{dm}{dt} - m\frac{dG}{dt}$$

for approximation of the changes between two discrete points of time we can write:

(9) $\Delta W \approx (1-G)\Delta m - m\Delta G$, where

$\Delta W = W_t - W_{t-1}$, $\Delta m = m_t - m_{t-1}$ and $\Delta G = G_t - G_{t-1}$.

We will now use equation (9) to study changes in social welfare in terms of changes in equity and efficiency over 1982 to 1999.

Table 3 presents estimated values of the SWF and its arguments provided in equation (6).

Table 3

Changes in Social Welfare in Singapore: 1982, 1991, 1999

Year	Mean Income*	Gini coefficient	Social Welfare
1982	987.90	0.460	533.47
1991	1616.85	0.471	855.31
1999	2642.63	0.476	1384.74

* In constant 1985 Singapore dollars

The increase in inequality (quantified by the Gini coefficient) is quite prominent during the period 1982 to 1991. Real mean income during this period in Singapore increased by 7.1% on average per annum. Thus, for this period the increase in inequality is overshadowed by the increase in real income. The social welfare, measured by SWF, shows an increasing movement throughout the whole period. During 1982 to 1991 welfare increased by 6.7% (on average per annum) and during

1991 to 1999 welfare increased by 7.7% per annum (on average) and in the whole period the average increase was 9.39% per annum. Thus in terms of complete ranking we observe that the year 1999 dominates the other two years. To enumerate the change in social welfare of Singapore attributed to the changes of equity and efficiency we present Table 4.

Table 4

Change in Welfare and its Components in Singapore: 1983-84 – 1993-94

	1982 to 1991	1991 to 1999
Welfare change	321.844	529.428
Mean change	628.945	1025.787
Inequality change	-0.011	-0.005
Due to mean: $(1-G)\Delta m$	336.170	540.076
Due to inequality: $m\Delta G$	-14.326	-10.649

Table 4 shows that the change in welfare due to inequality is not low. We have already discussed that in the eighties the restructuring programme started paying better remuneration to the skilled workers while the unskilled were low-paid. With Government's equity enhancing education policies the labour market experienced better skilled entrants. However, the scarcity of manpower in Singapore embraced foreign workers to a large scale. On one hand skilled foreign workers are hired at a high wage, on the other hand construction workers and domestic maids are employed at a very low wage. Thus disparity of income continues to be high.

In the above table we observe an increase in social welfare, despite increase in inequality as the changes due to mean, at both the intervals, are quite high. Singapore is among the High Performing "miracle" countries, which maintains an average annual growth rate of 4.7% (average annual GNP) during 1980-90 and 5.8% during 1990-98. World Bank (1993: 5-6) identified the following causes for this high growth rate: high rate of investment in physical and human capital, export orientation, fertility decline, sound macroeconomic management helping to promote savings and investment, and government intervention to promote development of specific industries.[9]

[9] Singapore maintained 40-50% of GDP as gross domestic savings during 1980s and 1990s and while in the 1980s saving-investment gap was 5%, in 1990s it hovers around 15%. The average ratio of gross domestic capital formation to GDP in 1980s was 42%, while it is 35% for 1990s. The incremental capital output ratio in the 1980s was 5.2 and in the 1990s it was 4.2. In the 1980s the inward FDI flow was 32% of gross domestic investment and 1990s maintain an average figure of 25%.

VII Avoiding too much Emphasis on Efficiency

For the S-D-Y-S SWF the rate of substitution between inequality and efficiency at a constant welfare level can be given by:

$$(10) \qquad \frac{dG}{dm} = \frac{1-G}{m}$$

Thus for the Singapore case, the rates of substitution are 0.0006, 0.0003 and 0.0002 for the years 1982, 1991 and 1999 respectively. That means, in 1982 if the government wanted to have a growth policy, which would increase mean income by 100 units, a deterioration of the Gini by 0.06 point would be admissible. Note that in 1982 the Gini was 0.460 and the mean income was $987.90. Now in 1999 when the country's mean income is $2642.63 and Gini is 0.476, for a policy of same growth rate a 0.02 point deterioration of Gini is admissible. The point to emphasise here is that, compared to 1982, in 1999 when the average income was almost three times, more importance should be given on preservation of equity. Therefore, clearly the SWF is highly sensitive to mean income and less sensitive to inequality. Thus, in the case of inter-temporal comparison, this SWF will always be biased as Singapore's per capita income increases at a very high rate even at the cost of an adverse income distribution. Furthermore, both the mean income and the Gini are determined by the income profile of society, and thus this SWF is extremely rigid from the policy point of view.

In addition, an underlying assumption in the S-D-Y-S SWF is the following:

$$(11) \qquad \frac{\partial W}{\partial x_i} > 0 \quad \text{for all } i$$

This means that any addition to anyone's income, other things remaining the same, must increase social welfare. This assumption is called Paretianity. Thus, (to take an extreme case) if there is an increase of income of the richest person (or section) of the society, welfare will increase. Note that *ceteris paribus*, an increase in the richest person's income will increase inequality as well as total income. But the increase in welfare due to the increase in total income must be greater than the decrease in welfare due to the increase in inequality. This means that (11) implies:

(12) $$\frac{\partial W}{\partial S}\frac{\partial S}{\partial x_i}dx_i + \frac{\partial W}{\partial q}\frac{\partial q}{\partial x_i}dx_i > 0$$

this principle deals with the "efficiency" aspect of the SWF. If the efficiency gain of the entire society is enjoyed by the richest person (or group) whether it is a welfare gain or not is the question.

The S-D-Y-S SWF may be easily modified to make it more general and flexible. Such a class of generalized SWF can be presented as:

(13) $W = m^{\beta}(1 - G), \quad 0 \le \beta \le 1$

This SWF with variable values of β has certain advantages over the S-D-Y-S SWF. If one wants to attach more importance to efficiency than equity he will choose a high value of β, that is near one, and on the contrary if he is an equity-lover he will set a low value for β.[10]

Let us now examine whether this SWF is Paretian or not. From equation (11) we know that the SWF is Paretian if:

(14) $$\frac{\partial}{\partial x_i}[m^{\beta}(1-G)] > 0$$

which implies:

(15) $$\beta - \beta G + G > \frac{2i-n-1}{n}, \text{ for } i=1,..,n$$ [11]

This expression is always true from the lowest income to the median income as the left hand side of expression (15) is always positive. With the knowledge of the existing level of inequality in the society, by varying the value of β, one can easily determine the direction of a change in social welfare when a person, above the median, gains some additional income (other things remaining the same). If the condition of Paretianity is satisfied for the richest person it will satisfy others, thus putting maximum value of i in (15) we get:

[10] The value of β can be well above 1 for a more efficiency prone person, however whenever $\beta \ge 1$ the proposed SWF is Paretian (can easily be followed from the proof discussed next). As our argument is against Paretianity we are restricting ourselves to the upper limit 1, when it is the special case of S-D-Y-S SWF.

[11] The mathematical derivation is attached in the appendix.

(16) $\beta + G - \beta G > \frac{n-1}{n}$,

For a large n this can be written as:

(17) $\beta + G - \beta G \geq 1$

which will never be satisfied for a value of β less than 1. Thus this SWF is Paretian for the highest possible value of β, in which case this SWF will become the S-D-Y-S SWF. It is obvious from condition (17) that if only the richest person or the richest group enjoys the fruit of growth, the welfare of the society will not increase as long as $\beta<1$. This SWF might be criticised for its bias in favour of the poor. If there is a rise in income of the poorest whatever be the value of β and G (in the specified range, that is, between 0 and 1), the welfare must increase. Thus this SWF has some Rawlsian flavour. However, for a Rawlsian SWF if the richest person's income increases, social welfare remains unchanged; but for the modified SWF (with $\beta<1$) with an increase in income of the richest person social welfare decreases. This class of SWF (with $\beta<1$) is not Rawlsian and not Paretian either.

Now, let us examine the changes in social welfare in Singapore for various values of β.

Table 5

Change in Social Welfare in Singapore When Judgement Varies

	$\beta = 0.00$	$\beta = 0.01$	$\beta = 0.05$	$\beta = 0.10$	$\beta = 0.50$	$\beta = 1.00$
1982	0.540	0.579	0.762	1.076	16.973	533.467
1991	0.529	0.570	0.765	1.107	21.271	855.311
1999	0.524	0.567	0.777	1.152	26.937	1384.739
Change						
1982 to 1991	-0.011	-0.009	0.003	0.031	4.298	321.844
1991 to 1999	-0.005	-0.003	0.012	0.045	5.666	529.428

Table 5 depicts the situation in social welfare when we consider a more general SWF. When consideration of efficiency is either nil ($\beta = 0$) or negligible (in the above table, $\beta = 0.01$) we observe a decrease in welfare in Singapore over the years. However, considering social welfare only on the basis of equity (here determined by the expression 1 minus Gini), is too extreme. Also when we consider the value of $\beta = 0.01$, we are almost neglecting the effect of growth in the society. To consider the effect of growth on various sections of the society let us re-examine Table 2 recast as Table 6.

Table 6

Increase in Mean Income of Various Decile Groups

Decile	1982	1991	1999	Change: 1982 to 1991	Change: 1982 to 1991
Lowest	24.32	23.27	32.82	-1.05	9.55
Second	37.85	59.66	76.52	21.81	16.86
Third	37.84	76.51	116.94	38.67	40.43
Fourth	51.05	86.88	121.17	35.83	34.29
Fifth	63.07	107.25	169.05	44.18	61.8
Sixth	63.08	130.72	192.09	67.64	61.37
Seventh	83.25	155.16	226.9	71.91	71.74
Eighth	98.09	188.34	300.11	90.25	111.77
Ninth	145.04	262.77	384.84	117.73	122.07
Top	384.31	526.29	1022.19	141.98	495.9
Total	987.9	1616.85	2642.63	628.95	1025.78

Computed from LFS, 1982, 1991, 1999

Table 6 clearly shows that incomes of the poorer deciles increased by the least amount, while a decrease in the mean income of the first decile is seen between 1982 to 1991. However, it is clear that the fruit of growth, except for the above case, does not accrued *totally* to the richest section of the society. But there should be concerns on the matter that the richest 20% people are benefiting most from the economic growth in Singapore.

VIII Comparison of Social Welfare from other Perspectives

Inequality and consequently social welfare are multi-dimensional phenomena. Thus a discussion of social welfare in terms of income only is too restrictive. This section will provide some further details of change in social welfare in Singapore. For this we first present Table 7.

Table 7

Various Key Social Indicators: Singapore: 1982, 1991, 1999

	1982	1991	1999
Life Expectancy at Birth (year)	71.8 *	75.7	77.6
Adult Literacy Rate (%)	84.8	89.7	93.5
Government Recurrent Expenditure on Education per student (Real)			
Primary (Real)	14.83	23.22	25.74
Secondary (Real)	23.05	35.29	47.04
Tertiary (Real)	107.17	188.77	
Junior Colleges (Real)			58.27
Institute of Technical Education (Real)			66.89
Polytechnics (Real)			77.71
Universities (Real)			144.66
Government Operating Expenditure			
Government Expenditure on Education (% of total)	18.29	24.224	21.34
Government Spending on Health (% of GDP)	0.959	0.644	0.608
Government Spending on Public Housing (% of GDP)	-	0.070	0.117
Government Spending on Environment (% of GDP)	0.486	0.267	0.224
Rank in HDR+	Na	37 **	22
Crime Rate (Per 10,000 Population)***	167	193	101

Notes: * = World Development Indicators on CD Rom; **= Based on 1980, 85 and 88 data; += Human Development Report 2000; ***= The following points to be noted:

a) Indicator is computed based on resident population.

b) Data prior to 1998 were based on commutation of 12 months' figures. From 1998, data are as at end of period.

c) Refer to the total offences recorded

Rest of the variables were taken from the Human Development Report 2000

The above table indicates that Singapore Government's emphasis on the education sector has increased over time (slight decrease in expenditure on education as percentage of GNP in the 1999 is the aftermath of the financial crises). To respond to the public debate of increasing chasm between rich and the poor, in his National Day Lecture, 2000, Prime Minister Goh Chock Tong emphasized that the increase in inequality in the recent years is not a local phenomenon. Also he clarified that the income data does not include several in-kind opportunities which actually are meant for the poorer section of the society, such as education. Labour Force Survey Reports reveal that between 1982 and 1999, the educational level of labour force shifted upwards due to an increasing number of better educated entrants. The proportion of workforce with below primary education decreased from 24.4% in 1982 to 13.3% in 1999. While in 1982, 51% had less than secondary education, in 1999 the figure had decreased to 37.5%. The upper end of the education ladder has shown opposite

results with an almost three-fold increase in percentage of university graduates from 1982 to 1999. It is also observed from the above table that life expectancy at birth has increased over the years and the crime rate has decreased in Singapore.

It is already known that the high Gini is of concern to Singaporean policy makers. In Table 7 we see that the Government's recurrent expenditure per student has increased from $14.43 to $25.74 at the primary level and $23.05 to $47.04 at the secondary level in real terms. In the appendix we presented Tables 1A and 2A to provide a comparison of Singapore with other East Asian High Performing countries in the global context. These reveal that though Singapore is somewhat lower in the ranking of adult literacy in the global context, the performance is near Hong Kong and Thailand and better than of Malaysia and Indonesia. In terms of Secondary school enrolment Singapore's rank is quite high. Singapore is one of the highest achievers in terms of life expectancy and other health related indicators (viz, infant mortality rate and under 5 mortality rate).

World Development Report 2000/2001 publishes economic performances of 174 countries. We have extracted these countries, in Table 3A (see in the Appendix) where the Gini is more than 0.45. These countries are compared with Singapore for other social indicators. It can be observed that so far as life expectancy at birth for males, literacy rates of males, unemployment rate, under 5 mortality rate and infant mortality rates are concerned Singapore's achievement has been spectacular. However, Singapore's female illiteracy rate is 12%, far below Chile, Cambodia, Costa Rica and Panama where Ginis are more than 0.5 and per capita real GNPs (in $PPP) are almost one-fifth of Singapore.

In the list of 30 countries (in Table 3A) Singapore ranks 29th in terms of share of public expenditure on health. Second only to Japan, Singapore has the fastest growing ageing population in the world. The increasing proportion of aged leads to a demand for medical care. However, as part of privatization during 1980s, the government encouraged commercialization (to increase efficiency and reduce unnecessary demand) even in the health care system. Though there is assurance from the government on an affordable health care system equity aspect is eclipsed by the ever-increasing emphasis on economic efficiency and financial accountability.

Singapore spent 3% of its GNP in 1997 on Education. This proportion is also quite low compared to the other countries in the list. Lesotho, South Africa, Venezuela spent almost 8% of their GNP on education. Human Development Report, 1999 records that the average public education expenditure on high human development countries (Singapore comes under this category) as a percentage of GNP was 5 and that of medium human development countries (Singapore's neighbours Malaysia, Thailand, Indonesia, Viet Nam are the members of this category) was 3.8. This clearly indicates that though there is a high importance on the educational expansion in Singapore the allocated portion of GNP is comparatively not very high.

The data on social problems (eg, drug offences, reported rapes and recorded homicides) is not available for all the countries in the list. In the list Singapore ranks 29^{th} from the perspective of CO_2 emission per capita which indicates a high level of environment pollution. Thus we observe from other social indicators that Singapore's performance is mixed, in some of the cases it is spectacular and in some it is not very encouraging.

VII Conclusion

In this paper we examined the change in social welfare in Singapore using Labour Force Survey data of the years 1982, 1991 and 1999. To find the change and dominance both ordinal (Lorenz Dominance and Generalised Lorenz Dominance) and cardinal (Social Welfare Function) measures are used. It is found by Lorenz Dominance that the social welfare in Singapore during 1999 is less than 1991 and no unambiguous conclusion can be made on the welfare ranking of 1988 and 1991 or 1988 and 1999 as Lorenz curves of both these two periods intersect. To solve this crossing problem (the mean incomes of these years are changing, which creates another problem) and to introduce the concept of efficiency in the social welfare construct we analyzed and applied the Generalized Lorenz Dominance criteria. It was found that this criterion is unable to lead to any unambiguous ranking of these three years again because of the intersection. The ranking based on Sen-Dagum-Yitzhaki-Sheshinski Social Welfare Function shows a continuous increase in the social welfare

of Singapore. It was also found that the increase in inequality is overshadowed by the increase in mean income.

Considering the limitation of the S-D-Y-S SWF, which is Paretian and which gives too much emphasis on efficiency aspect, we introduced a more general SWF which could be non-Paretian in special cases. With this SWF we found that when the emphasis on equity is very high, social welfare in Singapore is decreasing. It is observed that, with only one exception, although the fruit of growth was distributed always to all sections of people, the richest section benefits the most. We have also shown, using non-income factors, that social welfare in Singapore has increased in terms of better education, health and standard of living (quantified by decreased crime rate).

However, compared to the countries with high inequality (Gini more than 0.45) the performance of Singapore is found to be mixed. The achievement in terms of reducing unemployment rate, and infant and under-5 mortality rate is impressive. The life expectancy at birth is very remarkable. However, with this the health care for the aged needs attention. Measures are warranted for protecting the environment as well. A more aggressive attention is needed in the education sector as also.

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Appendix

Proof of Eq (15)

$$\frac{\partial W}{\partial x_i} = \frac{\partial}{\partial x_i}[m^b (1-G)]$$

$$= \frac{\partial}{\partial x_i}[(\sum \frac{x_i}{n})^b (1-\frac{\sum (2i-n-1)x_i}{n\sum x_i})], \text{ as } G = \frac{\sum (2i-n-1)x_i}{n^2 \bar{x}}$$

$$= \beta m^{b-1} \frac{1}{n}[1-G] + m^b [\frac{0-(2i-n-1)n^2 m + n\sum (2i-n-1)x_i}{(n\sum x_i)^2}]$$

$$= \frac{\frac{1}{n}\beta m^{b-1} n^4 m^2 (1-G) - n^2 m^{b+1}(2i-n-1) + m^b n\sum (2i-n-1)x_i}{(n^2 m)^2}$$

To satisfy Paretianity this expression has to be greater than zero – that means

$$\frac{1}{n}\beta m^{b-1} n^4 m^2 (1-G) + m^b n\sum (2i-n-1)x_i > n^2 m^{b+1}(2i-n-1)$$

$$\Rightarrow n^3 \beta m^{b+1}(1-G) + m^b n\sum (2i-n-1)x_i > n^2 m^{b+1}(2i-n-1)$$

$$\Rightarrow n\beta(1-G) + \frac{1}{nm}\sum (2i-n-1)x_i > 2i-n-1$$

$$\Rightarrow \beta(1-G) + \frac{\sum (2i-n-1)x_i}{n^2 m} > \frac{2i-n-1}{n}$$

$$\Rightarrow \beta - \beta G + G > \frac{2i-n-1}{n}$$

for i=1,..,n

Table 1A

Education Indicators of Selected East Asian Countries within Global Context

Adult Literacy Rate, 1997 [Rank/ %]	Secondary School Enrolment, 1996 [Rank/ %]
Canada and 32 others [1/99]	Belgium [1/ 98]
South Korea [12/97.2]	South Korea [2/96]
Thailand [25/94.7]	Singapore [15/ na]
Hong Kong [29/ 92.4]	Hong Kong [18/ 71]
Singapore [33/91.4]	Malaysia [21/na]
Malaysia [43/85.7]	Thailand [27/ na]
Indonesia [45/85]	Indonesia [34/ 42]
Niger [121/ 14.3]	Mozambique [49/ 6]

Source: Rao (2001, Table 2.12a, p 19), na: not available

Table 2A

Health Indicators of Selected East Asian Countries within Global Context

Life Expectancy at Birth (years), 1997 [Rank/ Years]	Infant Mortality Rate, 1997 [Rank/ Rate]	Under 5 Mortality Rate, 1996 [Rank/ Rate]
Japan [1/ 80]	Singapore [1/ 4]	Singapore [1/ 5]
Hong Kong [4/ 78.5]	Hong Kong [2/ 5]	Hong Kong [2/6]
Singapore [11/ 77.1]	South Korea [5/ 9]	South Korea [7/11]
South Korea [40/ 72.4]	Malaysia [7/ 11]	Malaysia [9/ 14]
Malaysia [42/ 72]	Thailand [25/ 33]	Thailand [20/28]
Thailand [62/68.8]	Indonesia [32/ 47]	Indonesia [38/ 60]
Indonesia [77/ 65.1]		

Source: Rao (2001, Table 2.12b, p 19)

Table 3A

Singapore in Comparison with other economies with Gini >0.45

	Gini Index	Life expectancy at Birth (Yrs) (1998)		Adult Illiteracy Rate (% of people 15 & above) (1998)		Net Enrolment Ratio (% of relevant age group) (1997)		Public Expenditure on Education (% of GNP) (1997)
Countries		Males	Females	Males	Females	Primary	Secondary	
Brazil	60	63	71	16	16	97	66	5.1
Burkina Faso	48.2	43	45	68	87	32	13	1.5
Central African Republic	61.3	43	46	43	68	46	19	Na
Chile	56.5	72	78	4	5	90	85	3.6
Colombia	57.1	67	73	9	9	89	76	4.1
Costa Rica	47	74	79	5	5	89	40	5.4
Dominican Republic	48.7	69	73	17	17	91	79	2.3
EL Salvador	52.3	67	72	19	25	89	36	2.5
Guatemala	59.6	61	67	25	40	74	35	1.7
Honduras	53.7	67	72	27	27	88	36	3.6
Lesotho	56	54	57	29	7	69	73	8.4
Madagascar	46	56	59	28	42	61	Na	1.9
Malaysia	48.5	70	75	9	18	100	64	4.9
Mali	50.5	49	52	54	69	38	18	2.2
Mexico	53.7	69	75	7	11	100	66	4.9
Nicaragua	50.3	66	71	34	31	79	51	3.9
Niger	50.5	44	48	78	93	24	9	2.3
Nigeria	50.6	52	55	30	48	-	Na	0.7
Panama	48.5	72	76	8	9	90	71	5.1
Papa New Guinea	50.9	57	59	29	45	-	Na	Na
Paraguay	59.1	68	72	6	9	96	61	4
Peru	46.2	66	71	6	16	94	84	2.9
Philippines	46.2	67	71	5	5	100	78	3.4
Russian Federation	48.7	61	73	0	1	100	88	3.5
Sierra Leone	62.7	36	39	Na	Na	Na	Na	Na
Singapore (*)		75 (1)	79 (2)	4 (3)	12 (11)	91 (11)	76 (8)	3 (16)
South Africa	59.3	61	66	15	16	100	95	7.9
Venezuela, RB	48.8	70	76	7	9	83	49	5.2
Zambia	49.8	43	43	16	31	72	42	2.2
Zimbabwe	56.8	50	52	8	17	93	59	-
Average		57.9	62.2	20.896	27.172	80.555	56.5	3.7

Table 3A Continued….

	Public Expenditure on Health (% of GDP)	Real Per Capita GNP ($PPP)	Rank in HDR*	Unemployment Rate (% of total labor force) *		Under 5 Mortality Rate per 1,000 (1998)		Infant Mortality Rate Per 1,000 lives birth	
Countries	(1990-98)	(1999)		(1980-82)	(1994-97)	(1980)	(1998)	(1980)	(1998)
Brazil	3.4	6317	74	2.8	6.9	80	40	70	33
Burkina Faso	1.2	898	172	Na	Na	Na	210	121	104
Central African Republic	1.9	1131	166	Na	Na	Na	162	117	98
Chile	2.4	8370	38	10.4	5.3	35	12	32	10
Colombia	4.9	5709	68	Na	12.1	58	28	41	23
Costa Rica	6.9	5770	48	5.9	5.7	29	15	19	13
Dominican Republic	1.6	4653	87	-	15.9	92	47	76	40
EL Salvador	2.6	4048	104	12.9	8	120	36	84	31
Guatemala	1.5	3517	120	Na	-	-	52	84	42
Honduras	2.7	2254	113	Na	3.2	103	46	70	36
Lesotho	3.7	2058	Na	Na	-	168	144	119	93
Madagascar	1.1	766	141	Na	-	216	146	119	92
Malaysia	1.3	7963	61	Na	2.5	42	12	30	8
Mali	2	693	165	Na	Na	Na	218	184	117
Mexico	2.8	7719	55	Na	3.5	74	35	51	30
Nicaragua	4.4	2154	116	Na	-	143	42	84	36
Niger	1.3	727	173	Na	-	317	250	135	118
Nigeria	0.2	744	151	Na	-	196	119	99	76
Panama	6	5016	55	Na	14.3	36	25	32	21
Papa New Guinea	2.6	2263	133	Na	-	-	76	78	59
Paraguay	2.6	4193	81	4.1	8.2	61	27	50	24
Peru	2.2	4387	80	Na	7.7	126	47	81	40
Philippines	1.7	3815	77	4.8	7.4	81	40	52	32
Russian Federation	4.5	6339	62	Na	11.3	-	20	22	17
Sierra Leone	1.7	414	174	Na	-	336	283	190	169
Singapore (*)	1.1 (29)	27024 (1)	24	2.6 (1)	2.4 (1)-	13 (1)	6 (1)	12 (1)	4 (1)
South Africa	3.2	8318	103	Na	5.1	91	83	67	51
Venezuela, RB	3	5268	65	5.9	10.3	42	25	36	21
Zambia	2.3	686	153	Na	Na	149	192	90	114
Zimbabwe	3.1	2470	130	Na	Na	108	125	80	73
Average	2.627	3622		2.744	5.408	113.167	85.233	77.1	54.033

Table 3A Continued….

	Co2 Emissions Per Capita Metric Tons		Total Recorded Drug Offences, Per 100,000 Peoples *	Recorded Rapes Per 100,000 women aged 15 & above*	Recorded Homicides in country, Per 100,0000 people*
Countries	(1990)	(1996)	(1994)	(1994)	(1994)
Brazil	1.4	1.7	Na	Na	Na
Burkina Faso	0.1	0.1	Na	Na	Na
Central African Republic	0.1	0.1	Na	Na	Na
Chile	2.8	3.4	62.9	19.1	4.5
Colombia	1.6	1.7	40	15.2	78.6
Costa Rica	1	1.4	13.8	26.4	9.7
Dominican Republic	1.3	1.6	Na	Na	Na
EL Salvador	0.5	0.7	Na	Na	Na
Guatemala	0.6	0.7	Na	Na	Na
Honduras	0.5	0.7	Na	Na	Na
Lesotho	Na	Na	Na	Na	Na
Madagascar	0.1	0.1	2.2	1.3	0.4
Malaysia	3	5.6	53.1	15.5	Na
Mali	0	0	Na	Na	Na
Mexico	3.5	3.8	Na	Na	Na
Nicaragua	0.7	0.6	22.4	109.7	25.6
Niger	0.1	0.1	Na	Na	Na
Nigeria	0.9	0.7	Na	Na	Na
Panama	1.3	2.5	115.3	34.1	12.5
Papa New Guinea	0.6	0.5	Na	Na	Na
Paraguay	0.5	0.7	Na	Na	Na
Peru	1	1.1	Na	Na	Na
Philippines	0.7	0.9	-	12.2	9.5
Russian Federation	13.1	10.7	Na	Na	Na
Sierra Leone	0.1	0.1	Na	Na	Na
Singapore (*)	15.5 (29)	21.6 (29)	62.9	6.4	1.7
South Africa	8.3	7.3	Na	Na	Na
Venezuela, RB	5.8	6.5	Na	Na	Na
Zambia	0.3	0.3	3.7	15.7	15.8
Zimbabwe	1.7	1.6	94.1	101.2	16
Average	2.314	2.648			

Notes: * columns were taken from Human Development Report 2000.
All other variables were taken from World Development Report 2000/2001.
(*) Numbers in bracket represent the rank of Singapore for the respective variables.
1982 and 1997 were only considered for the unemployment rate in Singapore and these figures were taken from the Singapore, Yearbook of Statistics 1997 and 1995.